VERIFICATION OF TRANSLATION

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in Japan

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am the translator of the documents attached and I verify that the attached is a true translation to the best of my knowledge and belief.

Signature of translator: Kiyotaka Ochiai
Kiyotaka Ochiai

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[Title of the Invention] Transmission Power Control Scheme in CDMA Mobile Communication System

[Claim or Claims]

[Claim 1] A transmission power control scheme in a mobile communication system using the code division multiple access scheme characterized by:

a base station which monitors a forward-link transmission power value radiated to a mobile station and when output reduction by which the forward-link transmission power value becomes smaller than a predetermined steady output value is detected, notifies said mobile station of a transmission power initial constant of a system parameter of said mobile station, which is calculated in correspondence with the reduced forward-link transmission power value; and

a mobile station which receives the transmission power initial constant and when said mobile station in a standby state starts originating/terminating to/from said base station, determines a transmission power value of a reverse-link control channel on the basis of a value obtained from a reception field strength value of the forward-link control channel from said base station and the transmission power initial constant.

[Claim 2] A transmission power control

scheme in a mobile communication system using the code division multiple access scheme characterized by:

a base station which monitors a forward-link transmission power value radiated to a mobile station and when output reduction by which the forward-link transmission power value becomes smaller than a predetermined steady output value is detected, notifies said mobile station of a transmission power correction value representing a difference from a transmission power initial constant of a system parameter of said mobile station, which is calculated in correspondence with the reduced forward-link transmission power value; and

a mobile station which receives the transmission power correction value and when said mobile station in a standby state starts originating/terminating to/from said base station, determines a transmission power value of a reverse-link control channel on the basis of a value obtained from a reception field strength value of the forward-link control channel from said base station and the transmission power correction value.

[Claim 3] A transmission power control scheme in a mobile communication system using the code division multiple access scheme comprised of a mobile station which is notified from a base station of a transmission power initial constant used in determining

a transmission power value of a reverse-link control channel to be sent from a mobile station in a standby state and determines a transmission power value of a reverse-link control channel on the basis of a value obtained from a reception field strength value of a forward-link control channel from the base station and the transmission power initial constant, characterized in that

the base station comprises means for monitoring a forward-link transmission power value radiated to the mobile station and when output reduction by which the forward-link transmission power value becomes smaller than a predetermined steady output value is detected, informing the mobile station of a transmission power initial constant of a system parameter of the mobile station, which is calculated in correspondence with the reduced forward-link transmission power value, and

the mobile station comprises means for receiving the transmission power initial constant and when the mobile station in a standby state starts originating/terminating to/from the base station, determining a transmission power value of a reverse-link control channel on the basis of a value obtained from a reception field strength value of the forward-link control channel from the base station and the transmission power initial constant.

[Claim 4] A transmission power control scheme in a mobile communication system using the code division multiple access scheme comprised of a mobile station which is notified from a base station of a transmission power initial constant used in determining a transmission power value of a reverse-link control channel to be sent from a mobile station in a standby state and determines a transmission power value of a reverse-link control channel on the basis of a value obtained from a reception field strength value of a forward-link control channel from the base station and the transmission power initial constant, characterized in that

the base station comprises means for monitoring a forward-link transmission power value radiated to the mobile station and when output reduction by which the forward-link transmission power value becomes smaller than a predetermined steady output value is detected, informing the mobile station of a transmission power correction value representing a difference from a transmission power initial constant of a system parameter of the mobile station, which is calculated in correspondence with the reduced forward-link transmission power value, and

the mobile station comprises means for receiving the transmission power initial constant and when the mobile station in a standby state starts

originating/terminating to/from the base station, determining a transmission power value of a reverse-link control channel on the basis of a value obtained from a reception field strength value of the forward-link control channel from the base station and the transmission power correction value.

[Detailed Description of the Invention]

[0001]

[Technical Field to Which the Invention Belongs]

The present invention relates to a transmission power control scheme in a mobile communication system using the CDMA (Code Division Multiple Access) scheme and, more particularly, to a transmission power control scheme in malfunction of the transmitting unit of a base station and a decrease in transmission power.

[0002]

[Background Art]

Along with the recent progress in electronic communication technology, mobile communication systems such as automobile telephones and portable telephones are rapidly proliferating. At the same time, the mobile communication scheme is also shifting from the TDMA (Time Division Multiple Access) scheme to the CDMA (Code Division Multiple Access) scheme.

[0003]

The cellular mobile communication system using the CDMA scheme generally has the following advantages.

① The system has high resiliency against interference such as radio interference or disturbance.

② The system rarely interferes with another system because the power spectrum density is low.

③ The system is excellent in security because the power spectrum density is low.

④ The system can realize satisfactory privacy protection by spreading codes.

⑤ Use of different spreading codes allows multiple access.

⑥ Overload communication is possible.

[0004]

However, the system has not only the advantages but also problems. One of the problems is the interference problem. A typical interference problem is the near-far problem. The near-far problem is a phenomenon in which during communication between a base station and a desired mobile station at a remote site, another interfering mobile station near the base station gives large disturbance to the desired mobile station that is communicating. Such an interference problem is not limited to the CDMA. Even for a conventional mobile communication system, this problem is known as interchannel interference (single channel

interference/neighboring channel interference). This problem is especially conspicuous in the CDMA because a number of mobile stations share a single frequency.

[0005]

To solve the interference problem, a mobile communication system using the CDMA scheme has various transmission power control means for reducing the interference amount. Such a transmission power control means includes a reverse-link (up-link) transmission power control means from a mobile station to a base station and a forward-link (down-link) transmission power control means from a base station to a mobile station.

[0006]

A reverse-link transmission power control means based on the TIA/EIA (Telecmmunication Industry Assciation/Electronic Industry Assciation) IS-95 standard will be described next. Reception quality measurement in a reverse-link transmission power control means is done by the receiving section of a base station. A base station measures the reception quality of a radio signal sent from a mobile station, and if the reception quality is more than a predetermined threshold value, instructs the mobile station by a power control bit to reduce the transmission power. If the reception quality is less than the predetermined threshold value, the base station instructs the mobile station by a power control

bit to increase the transmission power. This reverse-link transmission power control means is called a closed-loop transmission power control scheme.

[0007]

[Problem to be Solved by the Invention]

However, the conventional reverse-link transmission power control scheme has the following problems. Fig. 4 is a conventional operation flow chart for explaining problems in the present invention. As shown in Fig. 4, the mobile station in standby operation has completed synchronization acquisition with the base station and is set in the idle state while performing control channel transmission/reception such as field measurement in the peripheral zone and position registration according to a change in position (step b1). The mobile station in this state has already received from the base station system parameters related to the mobile station and stored their values therein when powered on.

[0008]

System parameters related to a mobile station are a plurality of constants that define the system conditions of the mobile station in the mobile communication system, and are determined in advance in designing the entire system including the base station. The system parameters related to the mobile station are stored in the base station together with system

parameters related to the base station. When a new mobile station is activated, the system parameters related to the mobile station are transferred from the base station to the mobile station via a control channel.

[0009]

Assume that the transmitting unit (TX) of the base station malfunctions to make the forward-link transmission power of the base station lower than a predetermined steady transmission output (step b2), and then, the mobile station in the standby state shifts to originating or terminating operation.

[0010]

For the reverse-link control channel at the mobile station that is shifting to originating or terminating operation, since transmission power control operation by a closed loop is not activated, transmission power control operation by the mobile station alone is activated. In the basic operation of transmission power control performed by the mobile station alone, near the mobile station (at a point where the reception field strength of the forward-link control channel at the mobile station is high), the reverse-link transmission power of the mobile station is set to be low in order to reduce the reverse-link interference amount at the base station. On the other hand, at a point far from the base station (at a point where the reception field strength of the forward-link control

channel at the mobile station is low), the reverse-link transmission power of the mobile station is set to be high in order to ensure the speech communication quality.

[0011]

Hence, the reverse-link control channel at the mobile station that is shifting to originating or terminating operation is set to transmission power whose value is the sum of a variable value inversely proportional to the reception field strength of the forward-link control channel from the base station and a fixed value based on the transmission power initial constant of the system parameters related to the mobile station (step b3). The control channel having the reverse-link transmission power value is radiated (step b4).

[0012]

That is, the reception field strength value of the forward-link control channel decreases in linkage with the reduced transmission power of the base station, and the transmission power value of the reverse-link control channel at the mobile station increases in inverse proportion to that reception field strength. For this reason, the amount of interference to the base station and neighboring base stations increases.

[0013]

If the communication shifts to the traffic channel (TCH) to perform actual speech communication,

transmission power control processing by a closed loop starts, and the reverse-link transmission power is controlled to an appropriate value (steps b5 and b6).

[0014]

As described above, when the transmission power of the base station abruptly decreases, the reception field strength of the forward-link control channel abruptly decreases, and consequently, the mobile station which is standing by in the service area of the mobile station erroneously recognizes that the mobile station has moved away from the base station in an instant. For this reason, the mobile station radiates transmission power more than the appropriate value in the reverse-link control channel in shifting to originating or terminating operation.

[0015]

The present invention has been made in consideration of the above situation, and has as its object to provide a transmission power control scheme which can decrease the transmission power of the reverse-link control channel at the mobile station in shifting to originating or terminating operation to an appropriate value and reduce the interference amount on the base station or a neighboring base station when the transmitting unit of the base station malfunctions to decrease the transmission power.

[0016]

[Means of Solution to the Problem]

According to the present invention, which has been made in order to solve the above problem, there is provided a transmission power control scheme in a mobile communication system using the code division multiple access scheme comprised of a mobile station which is notified from a base station of a transmission power initial constant used in determining a transmission power value of a reverse-link control channel to be sent from a mobile station in a standby state and determines a transmission power value of a reverse-link control channel on the basis of a value obtained from a reception field strength value of a forward-link control channel from the base station and the transmission power initial constant, wherein (イ) the base station comprises means for monitoring a forward-link transmission power value radiated to the mobile station and when output reduction by which the forward-link transmission power value becomes smaller than a predetermined steady output value is detected, informing the mobile station of a transmission power initial constant or transmission power correction value of a system parameter of the mobile station which is calculated in correspondence with the reduced forward-link transmission power value, and (ロ) the mobile station comprises means for receiving the

transmission power initial constant or transmission power correction value and when the mobile station in a standby state starts originating/terminating to/from the base station, determining a transmission power value of a reverse-link control channel on the basis of a value obtained from a reception field strength value of the forward-link control channel from the base station and the transmission power initial constant or transmission power correction value.

[0017]

According to the present invention, when the transmitting unit of a base station malfunctions, and the transmission power of the base station decreases, a transmission power initial constant or a transmission power correction value of new system parameters, which is calculated on the basis of the reduced base station transmission power value, is transferred from the base station to a mobile station which is standing by in the service area of the base station whereby the transmission power of the reverse-link control channel at the mobile station in originating or terminating can be decreased to an appropriate value.

[0018]

[Mode of Carrying Out the Invention]

An embodiment of the present invention will be described below with reference to the drawings. Fig. 1 is a block diagram showing the entire configuration of

an embodiment of the present invention. As shown in Fig. 1, a base station control unit 7 is connected to a base station 5 through a wired transmission approach line 6 formed from a leased line. The base station 5 can be connected to a mobile station 1 via a radio channel 3. The radio channel 3 comprises a reverse-link radio channel from the mobile station to the base station and a forward-link radio channel from the base station to the mobile station.

[0019]

An up-link unit of the base station 5 is constituted by a receiving section (RX) 10 for receiving a reverse-link radio signal transmitted from the mobile station 1, and a decoding section 11 for decoding the signal demodulated by the receiving section 10 into a reverse-link voice frame signal. A reception Eb/No (Eb/No = energy per bit/noise amount per Hz) as the reception quality of the signal decoded by the decoding section 11 is sent to a power control bit generation section 12. The power control bit generation section 12 compares the reception Eb/No with an internally generated reference Eb/No and generates a power control bit for controlling reverse-link transmission power of the mobile station 1. The decoded reverse-link voice frame signal is sent to the base station control unit 7.

[0020]

A down-link unit of the base station 5 is

constituted by an encoding section 14 for encoding a forward-link voice frame signal sent from the base station control unit 7, a transmitting section (TX) 13 for modulating the signal encoded by the encoding section 14 and then transmitting the signal, a transmission power control section 16 for calculating and appropriately changing forward-link transmission power on the basis of field strength information and reference Ec/Io (Ec/Io = signal to interference wave power ratio) sent from the base station control unit 7, a detecting section 19 for detecting a small transmission radio wave picked up by a directional coupler 15 which is provided midway along a feeder cable for connecting the antenna 4 and the output terminal of the transmitting section 13, a processing unit (CPU) 18 for monitoring the forward-link transmission power of the base station and controlling the entire base station by arithmetically processing the output from the detecting section, and a memory section 17 for storing system parameters as defined values related to the operations of the base station and mobile station, together with various kinds of control programs and control data.

[0021]

A down-link unit of the mobile station 1 is constituted by a receiving section (RX) 20 for receiving a forward-link radio signal transmitted from the base

station 5 and demodulating the signal, a decoding section 21 for decoding the signal demodulated by the receiving section 20 into a forward-link voice frame signal, a voice frame signal synthesis section 22 for performing weighting synthesis on the basis of voice data signal quality information in the forward-link voice frame signal, and a voice encoding section 26 for converting voice data in the forward-link voice frame signal into a forward-link voice signal.

[0022]

An up-link unit of the mobile station 1 is constituted by the voice encoding section 26 for converting a reverse-link voice signal into voice data in a reverse-link voice frame signal, an encoding section 24 for encoding the reverse-link voice frame signal, a transmitting section (TX) 23 for modulating the signal encoded by the encoding section 24 and then transmitting the signal, a transmission power control section 25 for appropriately changing transmission power on the basis of a power control bit sent from the base station 5, a processing unit (CPU) 28 for extracting from the voice frame signal synthesis section 22 system parameters related to the mobile station 1, which are sent from the base station 5, and controlling the entire mobile station, and a memory section 27 for storing extracted system parameters, together with various kinds of control programs and control data.

[0023]

Fig. 2 is an operation flow chart according to the present invention. As shown in Fig. 2, the mobile station 1 in standby operation has completed synchronization acquisition with the base station and is set in the idle state while performing control channel transmission/reception such as field measurement in the peripheral zone and position registration according to a change in position (step a1). The mobile station in this state has received from the base station system parameters related to the mobile station and stored their values in the memory section when powered on.

[0024]

When the transmitting unit (TX) 13 of the base station 5 malfunctions, the forward-link transmission power of the base station 5 becomes lower than a predetermined steady transmission output (step a2). The reduced transmission power value is detected by the detecting section 19 through the directional coupler 15 and input to the processing unit 18. The processing unit 18 compares the predetermined steady transmission power value to be reduced with the reduced transmission power value sent from the detecting section 19, thereby re-calculating the transmission power initial constant of the system parameters related to the mobile station. The re-calculated transmission power initial constant is stored (updated) in the memory section 17 of the base

station and simultaneously sent to the encoding section 14, which prepares for transfer of the re-calculated transmission power initial constant to the mobile station 1 via the transmitting unit 13 (step a3).

[0025]

Note that the newly calculated transmission power initial constant of the mobile station becomes smaller in proportion to the reduced base station transmission power value. The base station 5 transmits, to the mobile station 1 in standby operation, the new reduced transmission power initial constant (system parameter) of the mobile station using the forward-link control channel (step a4).

[0026]

The transmission power determination algorithm of the reverse-link control channel at the mobile station 1 when transmission power control operation by a closed loop is not activated will be described next. Fig. 3 is a view which explains the algorithm. As shown in Fig. 3, the base station 5 transmits the forward-link control channel at transmission power TXb. In this case, the mobile station 1 receives the forward-link control channel at a reception field strength RXb after subtraction of a propagation loss L (dB). The mobile station 1 which has received the forward-link control channel at the reception field strength RXb transmits the reverse-link control channel to the base station 5.

At this time, a transmission power TXm of the reverse-link control channel is determined to the sum of a variable value -RXb in inverse proportion to the reception field strength RXb and a transmission power initial constant (fixed value) A of the system parameters transferred in advance to the mobile station 1. The transmission power determination algorithm of the reverse-link control channel at the mobile station 1 when transmission power control operation by a closed loop is not activated has been described above.

[0027]

Referring back to Fig. 2, the mobile station 1 in the standby state shifts to originating or terminating operation. At this time, transmission power control operation by a closed loop has not been activated yet for the reverse-link control channel at the mobile station 1. For this reason, reverse-link transmission power based on the above-described algorithm (the sum of a variable value in inverse proportion to the reception field strength of the forward-link control channel and a transmission power initial constant transferred from the base station 5 to the mobile station 1) is set (step a5), and the control channel having the reverse-link transmission power value is sent (step a6).

[0028]

That is, the variable value in inverse

proportion to the reception field strength of the forward-link control channel from the base station 5 increases in linkage with the reduced transmission power from the base station. However, the new transmission power initial constant transferred from the base station 5 to the mobile station 1 is set to be small in linkage with the reduced transmission power from the base station. For this reason, the final transmission power value of the reverse-link control channel at the mobile station 1 does not increase, and the transmission power before the malfunction at the base station 5 is maintained. As a result, the interference amount on the base station and neighboring base station does not increase, and the transmission power of the reverse-link control channel at the mobile station 1 is appropriately controlled.

[0029]

If the communication shifts to the traffic channel (TCH) to perform actual speech communication, transmission power control by a closed loop starts, and the reverse-link transmission power is controlled to an appropriate value (steps a6 and a7).

[0030]

When the malfunction of the transmitting unit (TX) 13 of the base station 5 recovers, and the forward-link transmission power of the base station 5 is restored, the transmission power initial constant

(system parameter) of the mobile station is restored according to the above procedure.

[0031]

The base station according to the present invention has been explained above. The base station calculates the reduced transmission power initial constant and notifies the mobile station of it. However, a transmission power correction value may be calculated and informed as the difference from the initial transmission power initial constant before the transmission power of the base station decreases, instead.

[0032]

The mobile station according to the present invention has been explained above. Instead of determining the transmission power value of the reverse-link control channel on the basis of the value obtained from the reception field strength value of the forward-link control channel from the base station and the received transmission power initial constant, the transmission power value of the reverse-link control channel may be determined on the basis of the value obtained from the reception field strength value of the forward-link control channel from the base station and the transmission power correction value as the difference from the initial transmission power initial constant before the transmission power of the base

station decreases.

[0033]

[Effect of the Invention]

As seen from the above description, according to the present invention, when the transmitting unit of a base station malfunctions, and the forward-link transmission power of the base station becomes smaller than a predetermined steady transmission power, a new mobile station transmission power initial constant (system parameter) or a transmission power correction value, which is calculated on the basis of the reduced base station transmission power value, is transferred from the base station to a mobile station which is standing by in the service area of the base station whereby the transmission power of the reverse-link control channel at the mobile station in originating or terminating operation can be decreased to an appropriate value, and the interference amount on the base station or neighboring base station can be reduced.

[Brief Explanation of the Drawings]

[Fig. 1]

Fig. 1 is a block diagram showing the entire configuration of an embodiment of the present invention.

[Fig. 2]

Fig. 2 is an operation flow chart according to the present invention.

[Fig. 3]

Fig. 3 is an explanatory view which pertains to the transmission power determination algorithm of a reverse-link control channel at a mobile station 1 when transmission power control operation by a closed loop is not activated.

[Fig. 4]

Fig. 4 is a conventional operation flow chart for explaining problems in the present invention.

[Explanation of the Reference Numerals and Signs]

1: mobile station

2: antenna for mobile station

3: radio channel

4: antenna for base station

5: base station

6: wired transmission approach line

7: base station control unit

10: base station receiving section

11: base station decoding section

12: power control bit generation section

13: base station transmitting section

14: base station encoding section

15: directional coupler

16: base station transmission power control section

17: base station memory section

18: base station processing unit (CPU)

19: detecting section

20: mobile station receiving section

21: mobile station decoding section

22: voice frame signal synthesis section

23: mobile station transmitting section

24: mobile station encoding section

25: mobile station transmission power control section

26: voice encoding section

27: mobile station memory section

28: mobile station processing unit (CPU)

[Document Name] Abstract

[Abstract]

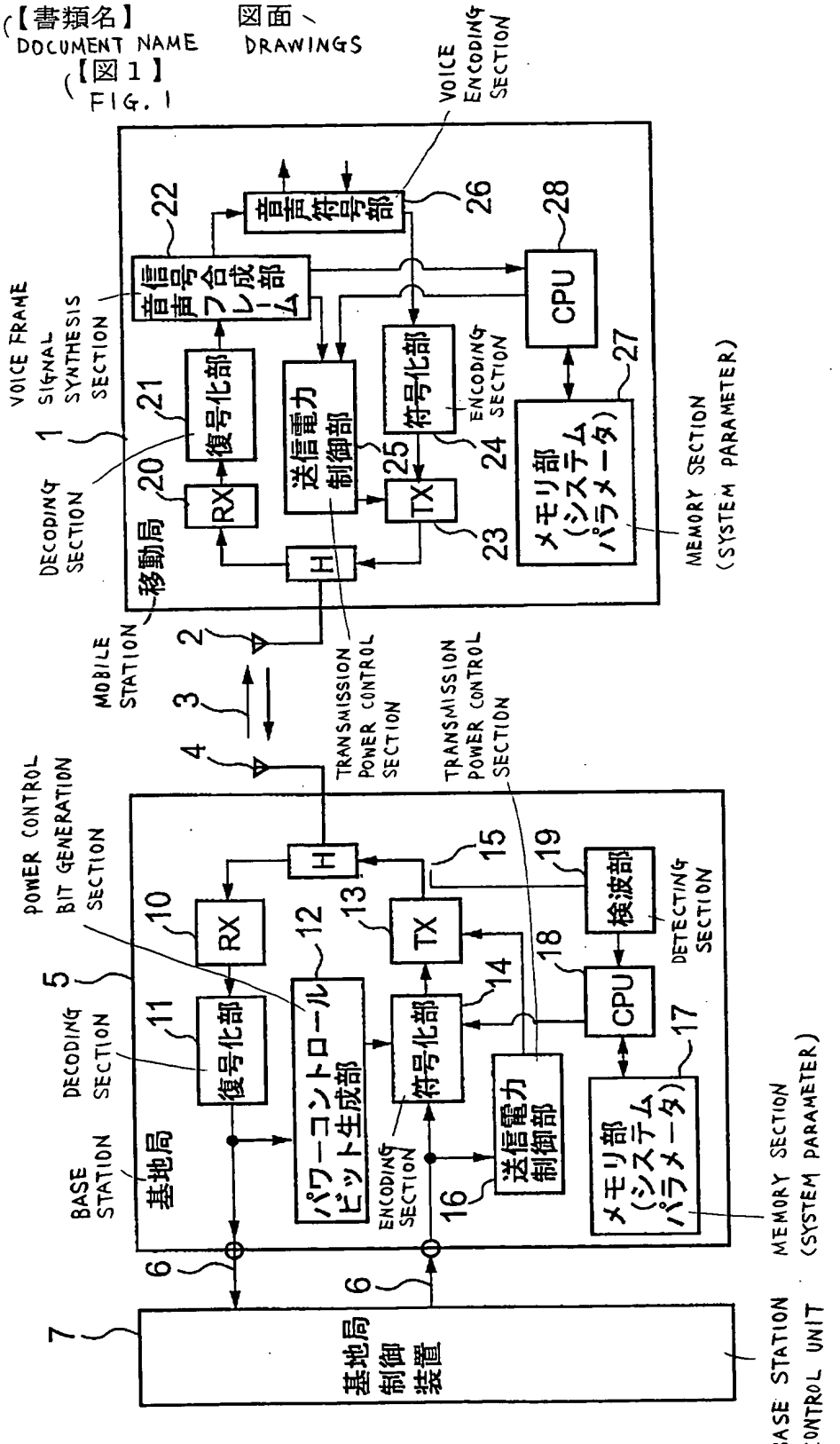
[Problem] There is provided a transmission power control scheme in which, when the transmitting unit of a base station malfunctions to decreases the transmission power, a mobile station which is standing by in the service area of the base station can control the transmission power of a reverse-link control channel in shifting to originating or terminating operation to an appropriate value.

[Solving Means] A new transmission power initial constant (system parameter) or a new transmission power correction value of a mobile station, which is calculated on the basis of a reduced base station transmission power value, is transferred from the base station to a mobile station which is standing by in the service area of the base station whereby the transmission power of the reverse-link control channel at the mobile station in shifting to originating or terminating operation can be decreased to an appropriate value.

[Selected Figure] Fig. 2

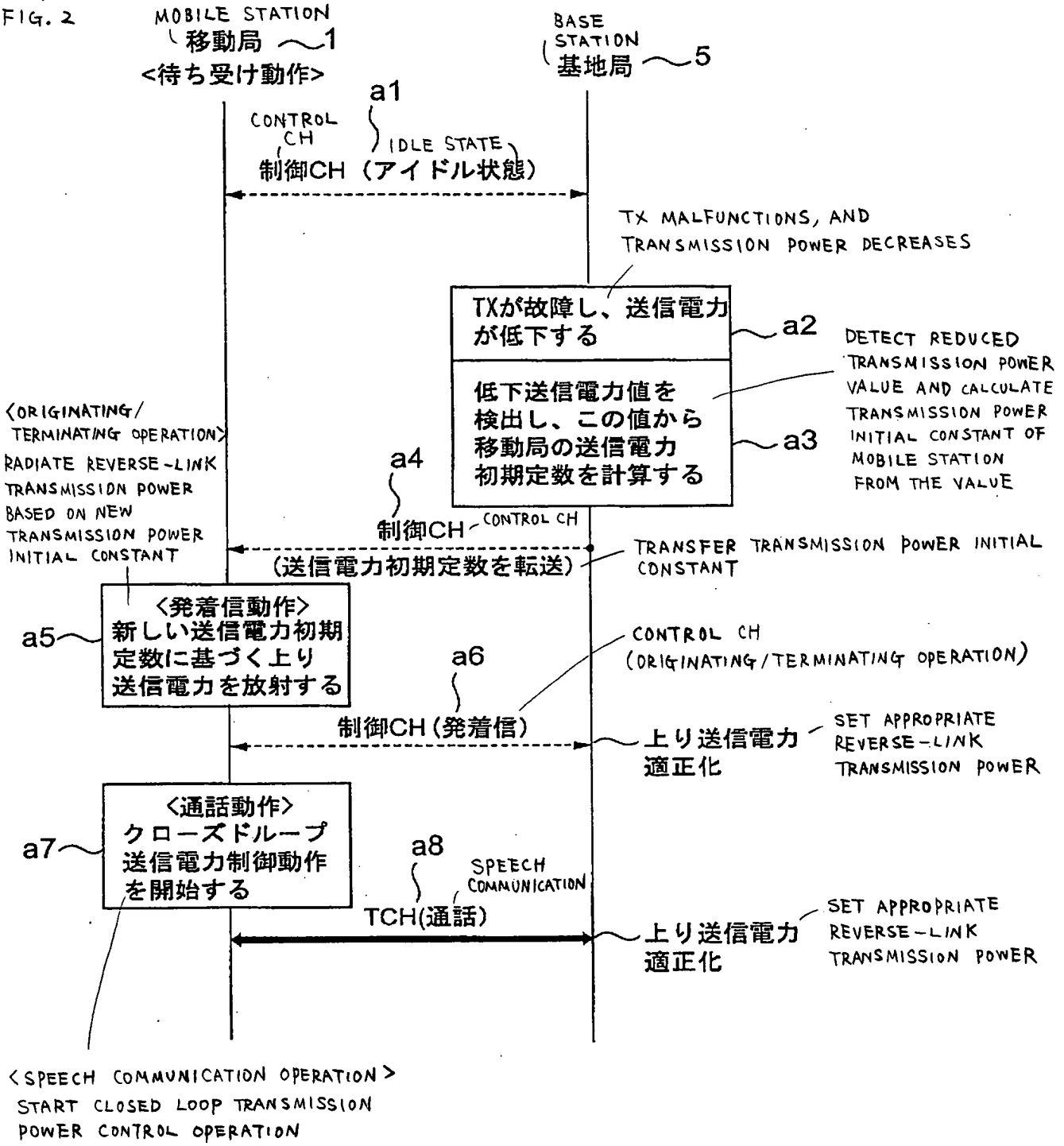
【書類名】　図面
DOCUMENT NAME　DRAWINGS

【図１】
FIG. 1

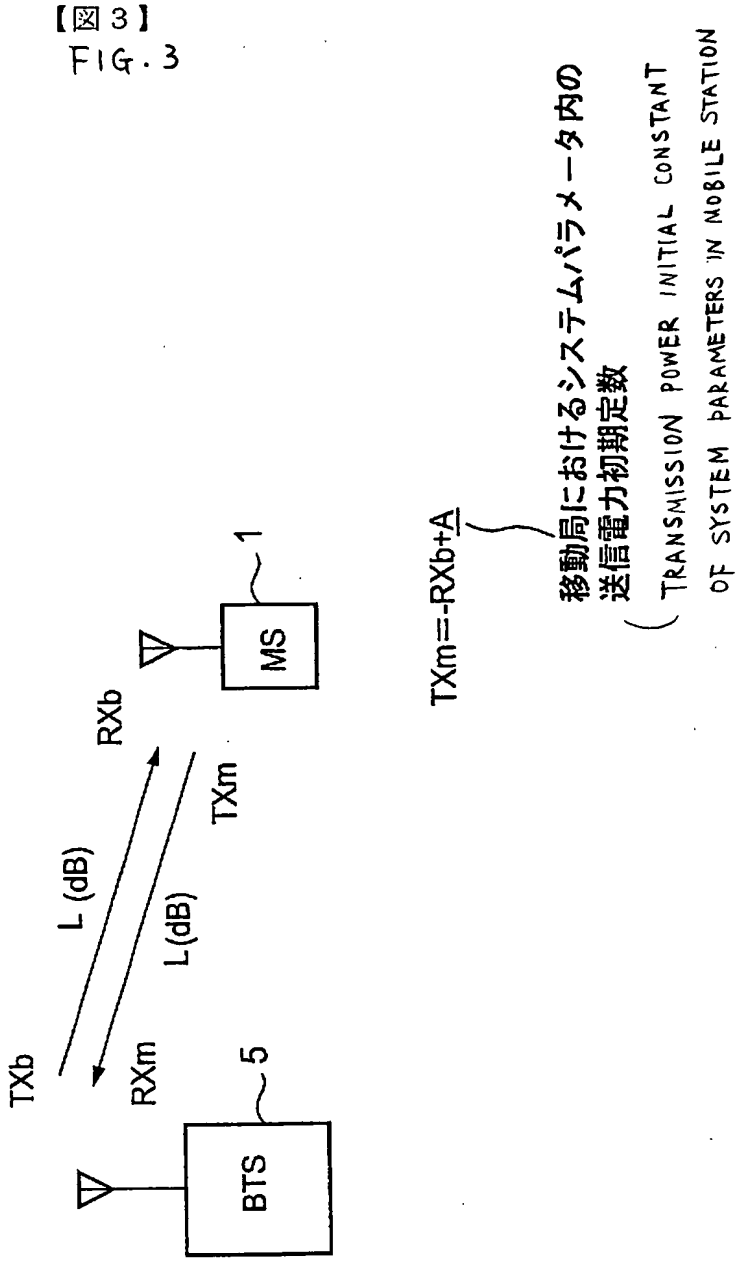


【図２】

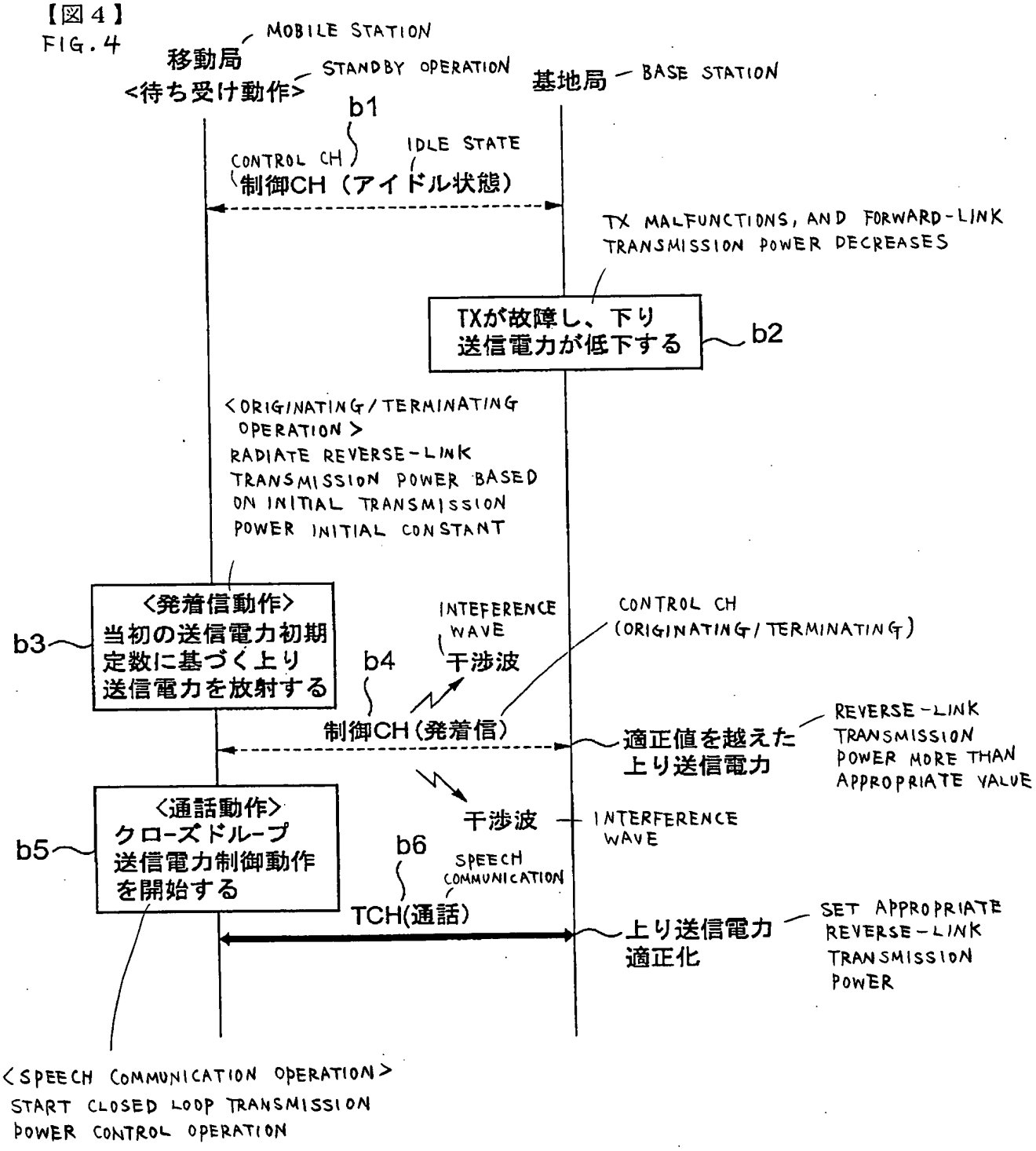
FIG. 2


MOBILE STATION
移動局 1
<待ち受け動作>
BASE STATION
基地局 5
a1
CONTROL CH
IDLE STATE
制御CH（アイドル状態）
TX MALFUNCTIONS, AND TRANSMISSION POWER DECREASES
TXが故障し、送信電力が低下する
a2
DETECT REDUCED TRANSMISSION POWER VALUE AND CALCULATE TRANSMISSION POWER INITIAL CONSTANT OF MOBILE STATION FROM THE VALUE
低下送信電力値を検出し、この値から移動局の送信電力初期定数を計算する
a3
<ORIGINATING/TERMINATING OPERATION>
RADIATE REVERSE-LINK TRANSMISSION POWER BASED ON NEW TRANSMISSION POWER INITIAL CONSTANT
a4
制御CH（送信電力初期定数を転送）
CONTROL CH
TRANSFER TRANSMISSION POWER INITIAL CONSTANT
<発着信動作>
新しい送信電力初期定数に基づく上り送信電力を放射する
a5
a6
制御CH（発着信）
CONTROL CH
(ORIGINATING/TERMINATING OPERATION)
上り送信電力適正化
SET APPROPRIATE REVERSE-LINK TRANSMISSION POWER
<通話動作>
クローズドループ送信電力制御動作を開始する
a7
a8
SPEECH COMMUNICATION
TCH(通話)
上り送信電力適正化
SET APPROPRIATE REVERSE-LINK TRANSMISSION POWER
<SPEECH COMMUNICATION OPERATION>
START CLOSED LOOP TRANSMISSION POWER CONTROL OPERATION

【図３】
FIG.3


TXm=-RXb+A
移動局におけるシステムパラメータ内の
送信電力初期定数
TRANSMISSION POWER INITIAL CONSTANT
OF SYSTEM PARAMETERS IN MOBILE STATION
1
MS
RXb
TXm
L (dB)
L(dB)
TXb
RXm
5
BTS

【図４】
FIG. 4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MOBILE STATION
<待ち受け動作>
STANDBY OPERATION
基地局
BASE STATION
b1
CONTROL CH
制御CH（アイドル状態）
IDLE STATE
TX MALFUNCTIONS, AND FORWARD-LINK TRANSMISSION POWER DECREASES
TXが故障し、下り送信電力が低下する
b2
<ORIGINATING/TERMINATING OPERATION>
RADIATE REVERSE-LINK TRANSMISSION POWER BASED ON INITIAL TRANSMISSION POWER INITIAL CONSTANT
<発着信動作>
当初の送信電力初期定数に基づく上り送信電力を放射する
b3
INTEFERENCE WAVE
干渉波
b4
CONTROL CH (ORIGINATING/TERMINATING)
制御CH（発着信）
適正値を越えた上り送信電力
REVERSE-LINK TRANSMISSION POWER MORE THAN APPROPRIATE VALUE
干渉波
INTERFERENCE WAVE
<通話動作>
クローズドループ送信電力制御動作を開始する
b5
b6
SPEECH COMMUNICATION
TCH(通話)
上り送信電力適正化
SET APPROPRIATE REVERSE-LINK TRANSMISSION POWER
<SPEECH COMMUNICATION OPERATION>
START CLOSED LOOP TRANSMISSION POWER CONTROL OPERATION